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On the Influence of the Temperature of Liquid Air on Bacteria."

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The experiments of Dr. Horace T. Brown and Mr. Escombe* have shown that no appreciable influence is exerted upon the germinative power of seeds, when exposed for 110 hours to the temperature of

* 'Roy. Soc. Proc.,' vol. 62, 1898, p. 160.

liquid air (- 183° C. to – 192° C.). The results were equally ne tive in the recent experiments of Sir W. Thiselton-Dyer,* in wh seeds survived exposure for upwards of six hours to the temperat of liquid hydrogen (– 250° C. to – 252° C.).

The following investigation on the influence of the temperature liquid air on bacteria, was carried out at the suggestion of Sir Jam Crichton Browne and Professor Dewar. The necessary facilities w most kindly given at the Royal Institution. The experiments w conducted under the personal supervision of Professor Dewar, and has asked me to put the results on record, although it must acknowledged that the essential features of the investigation are d to him.

The bacteria employed were selected from the stock of the Jenn Institute of Preventive Medicine, where the results were also c trolled. Pure cultures of the several micro-organisms were employ and the series included typical representatives of saprophytic a parasitic bacteria. The organisms chosen possessed varying degrees resistance to external agents—the extremes in this respect being rep sented by the very sensitive spirillum of *Cholera Asiatica* and t highly resistant spores of *B. anthracis*.

Ten organisms were used for the experiments, viz. :—*B. typhos B. coli communis*, *B. diphtheriæ*, *Spirillum choleræ Asiaticæ*, *B. prot vulgaris*, *B. acidi lactici*, *B. anthracis* (sporing culture), *Staphylococ pyogenes aureus*, *B. phosphorescens* and *Photobacterium balticum*.

The cultures of the organisms were young and vigorous, and we tested both on solid and in fluid media, viz. :—Nutrient gelatin, ag agar, potato and peptone broth.

The cultures on these media were simultaneously exposed to t temperature of liquid air for twenty hours (– 182° C. to – 190° C They were then carefully thawed and examined. The results m be briefly stated. In no instance, whether on solid or in liquid med could any impairment of the vitality of the micro-organisms detected. The fresh growths obtained from the exposed tubes we normal in every respect, and the functional activities of the bacte were equally unaffected. The colon bacillus produced its typi effects—such as the curdling of milk, the fermentation of sugar a the production of indol; the *Staphylococcus pyogenes aureus* retained pigment producing properties and the anthrax spores their pathoge action on animals. The photogenic bacteria preserved their norm luminous properties. These photogenic properties are intimate connected with the functional activities of the cells. The cells em light which is apparently produced by a chemical process of int cellular oxidation and the phenomenon ceases with the cessation their activity. These organisms therefore furnished a very hap

* 'Roy. Soc. Proc.,' vol. 65, 1899, p. 361.

of the influence of low temperatures on vital phenomena. Their
ures, when cooled down in the liquid air for twenty hours, became
luminous, but on re-thawing the luminosity returned with unim-
ed vigour as the cells renewed their activity. Watery emulsions of
photogenic bacteria, on immersion in liquid air for a few minutes,
ed to emit light, but on withdrawal the luminosity reappeared in
ry short time. Strips of filter paper soaked in the watery emul-
s and brightly luminous were immersed directly in the liquid air with
lar results. The sudden cessation and rapid renewal of the photo-
c properties of the cells, despite the extreme changes of tempera-
, was remarkable and striking.

he following experiment was made:—Fifty litres of the laboratory
bout six feet from the ground were liquefied at atmospheric pressure
glass bulb by means of boiling liquid air *in vacuo*. The tempera-
reached was about – 210° C. The bulb was then sealed off, the
ents being still at a temperature below zero, and was subsequently
ed and washed out with sterile broth. A series of plate cultures
made from the broth on nutrient gelatin, agar-agar and sugar agar,
were incubated under aërobic and anaërobic conditions at 22° and
C. for a period of ten days. The anaërobic plate cultures remained
le. The aërobic plates yielded forty-four organisms which had
ived an exposure to – 210° C. The organisms were representative
s of those to be usually met with in the air, viz., moulds, bacilli,
i, torulæ and sarcinæ.

may also be mentioned that a sample of yeast cell plasma
chner's zymase) subjected to – 182° C. to – 190° C. for twenty
s, retained its peculiar properties unchanged, viz., as regards the
uction of CO_2 and alcohol.

he above experiments show that bacteria may be cooled down
– 190° C. for a period of twenty hours without losing any of their
properties.

urther experiments are in progress with the above-mentioned and
other micro-organisms, exposed to the temperature of liquid air
till longer periods of time, as well as to that of liquid hydrogen.
se experiments will form the subject of a future communication.

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